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OMEGA
Model 700 Hand-held Digital Thermometer for Thermistors

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1. INTRODUCTION

1.1 General Description

The Model 700 Hand-held Digital Thermometer is a portable, accurate and reliable instrument ideally suited for lower temperature applications. It is compatible with all OMEGA "700" Series Thermistor Probes.

The Model 700 comes in two versions:

Model 700C — with a range of −30.0°C to +100.0°C
Model 700F — with a range of −22.0°F to +199.9°F

Each of the above models features a resolution of 0.1°. A rocker switch allows selection of two ranges to provide maximum resolution and versatility. The instruments are housed in an attractive, rugged high-impact plastic case fitted with a phone-plug receptacle. Other features include an easy-to-read LCD display and low-battery indicator.

The model operates on a standard 9-volt transistor battery or optional AC adaptor.

1.2 Features

- Compatible with OMEGA "700" Series Thermistor Probes
- 0.1° Resolution
- 3½ Digit LCD Display
- Receptacle for AC Adaptor
- Low-battery Indicator
- Selectable Ranges

1.3 Specifications

Temperature Range:

Model 700C −30.0°C to +100.0°C
Model 700F −22.0°F to +199.9°F

Resolution: 0.1°C, 0.1°F

Accuracy: ±0.5°C, ±0.85°F (Includes 700 Series Probe)

Ambient Temperature: 0°C to 40°C
32°F to 104°F

Display: 0.5" LCD

Power: One 9V battery or optional 110-VAC or 220-VAC AC line Adaptor

Battery Life: 200 hours continuous

Size: 5.4" L x 3.6" W x 1.9" H

Weight: 9.2 oz. (without battery)

1.4 Options and Accessories

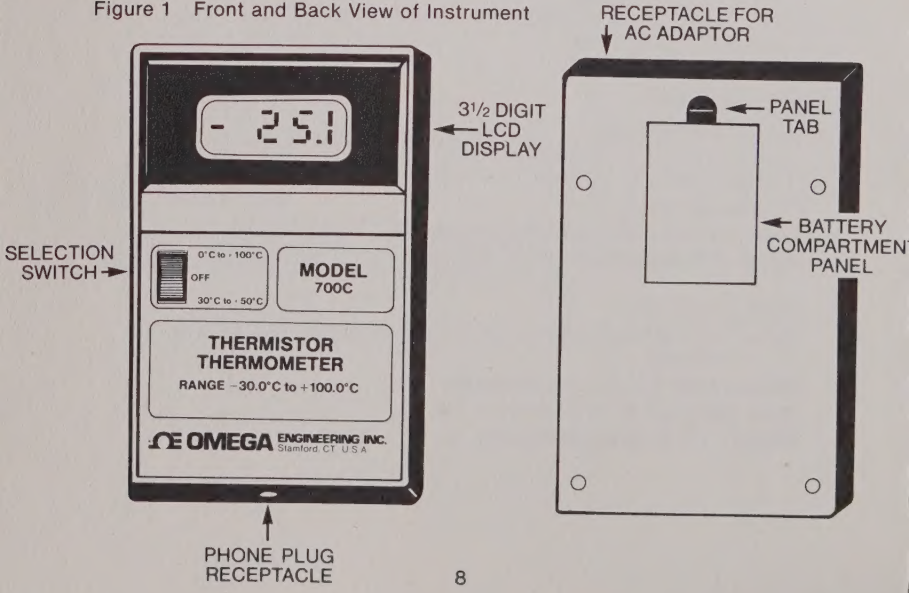
AC Adaptor	— 110-VAC or 220-VAC Adaptor is optional. 110-VAC Adaptor *(Catalog No. ACD-110)* 220-VAC Adaptor with DIN Standard European Plug *(Catalog No. ACD-220)*
Soft Carrying Case	— Constructed of vinyl-coated fabric. Case includes cutout for display, removable shoulder strap and spring clip belt attachment. *(Catalog No. SC-700)*
Rugged Carrying Case	— Constructed of high-impact plastic for heavy-duty use. Case is fitted with resilient foam insert with recessed storage areas for the instrument, AC Adaptor and temperature probe(s). *(Catalog No. RCC-700)*
Replacement Battery	— Single 9-volt battery: Mallory or equivalent. *(Catalog No. MN1604)*

2. OPERATION

2.1 Battery Installation

Use the specified 9-volt transistor battery. Lift off the panel from the back of the instrument by pushing the panel tab toward the panel

Figure 1 Front and Back View of Instrument



(see Figure 1). Place the battery into the compartment in accordance with the polarities indicated on the bottom of the compartment. Replace panel.

2.2 Battery Check and Replacement

When the battery voltage is low (7.5 volts or less), an arrow will appear in the upper left-hand corner of the display. To ensure instrument accuracy, replace the battery as soon as low-battery voltage is indicated.

When the instrument is not used for an extended period of time, remove the battery to minimize drain and prevent leakage.

2.3 AC Operation

Plug the optional AC Adaptor into the receptacle at the top of the unit. Power from the AC adaptor overrides the battery circuit; therefore, it is not necessary to remove the batteries for AC operation. Then plug the adaptor into a standard 110-VAC 60 Hz outlet. 220-VAC adaptors are supplied with a DIN European plug.

2.4 Probe Use

The OMEGA Model 700 is designed for use with an OMEGA "700" Series Thermistor assembly. The *OMEGA Temperature Measurement Handbook* features a broad selection of thermistors and probe assemblies.

2.5 Connectors

The OMEGA Model 700 has a built-in receptacle for a "phone plug" termination style. When ordering "700" Series Thermistor Probes from the *OMEGA Temperature Measurement Handbook*, add the suffix "PP" to the catalog number and specify "with phone plug."

2.6 Lead Wire

Accuracy specifications of the Model 700 are based on a probe with a lead resistance of 0.5 ohms or less for each of the three lead wires. Therefore, the length and gage of the copper leads should be taken into account. Up to 19 feet of 24-gage lead wire will have 0.5 ohms or less. The OMEGA "700" Series Thermistor Probes are normally supplied with 10 feet of 24-gage wire.

2.7 Measurement Instructions

1. Connect the thermistor probe to the Model 700 by inserting the phone plug firmly, all the way into the instrument.
2. Place the thermistor probe in thermal contact with the area being measured. The use of a high-thermal conductivity compound such as OMEGATHERM 201 will improve response time and accuracy when making measurements below 400°F (200°C). When measuring a liquid, immerse at least 1 inch of the probe.

3. Select a temperature range, then turn the instrument on by depressing the rocker switch to that range. (The choice of ranges depends on the temperature being measured. For example, for temperatures over 50°C or 32°F, the upper ranges should be selected.)
4. Allow the display on the instrument to stabilize before recording the reading. After each reading, turn the instrument off to prolong battery life.

3. CALIBRATION

3.1 Calibration Equipment

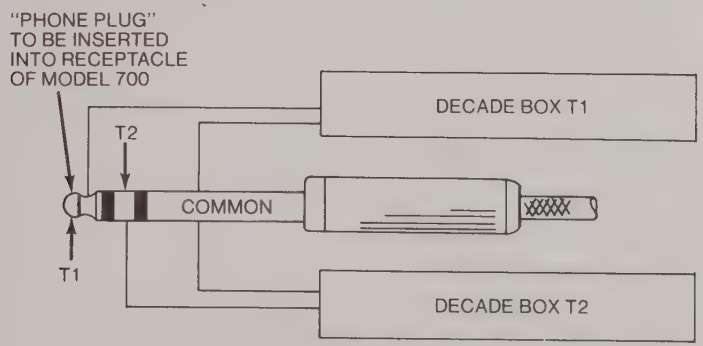
1. Two decade boxes (T1 and T2) are required to simulate the following resistance values:

T1	T2
19.59 K Ω	94.98 K Ω
549.8 Ω	2799 Ω
2162 Ω	10.97 K Ω
106.2 K Ω	481.0 K Ω

2. Wire assembly with phone plug (see Figure 2).
3. Calibrated DC voltage source (for Low Battery Arrow).

Figure 2

Set equipment up as follows:



3.2 Calibration Procedure

1. Open the Model 700 to expose the PC board by removing the 4 screws from the back of the case.
2. Refer to Section 4.2 and locate the 5 potentiometers (P1 through P5) on the PC board.

NOTE: In the following procedure, use values in parenthesis ( ) for Model 700F.

3. Set rocker switch on the Model 700 to the 0°C to +100°C (32°F to +199.9°F) position.
   a. Set: T1 to 19.59 K Ω, T2 to 94.98 K Ω — Adjust: P4 for a reading of 0.2°C (32.4°F)
   b. Set: T1 to 549.8 Ω, T2 to 2799 Ω — Adjust: P2 for a reading of 90.0°C (194.0°F)
   c. Repeat Steps "a" and "b" until both readings are correct.
   d. Set: T1 to 2162 Ω, T2 to 10.97 K Ω

   If the instrument has been correctly calibrated, it will read 50.0°C ± 0.1°C (122.0°F ± 0.2°F). If it does not, repeat calibration procedure.
4. Set rocker swtich to the −30°C to +50°C (−22°F to +122°F) position.
   a. Set: T1 to 19.59 K Ω, T2 to 94.98 K Ω — Adjust: P3 for a reading of 0.1°C (32.2°F)
   b. Set: T1 to 106.2 K Ω, T2 to 481.0 K Ω — Adjust: P1 for a reading of −30.0°C (−22.0°F)
   c. Repeat Steps "a" and "b" until both readings are correct.
   d. Set: T1 to 2162 Ω, T2 to 10.97 K Ω

   If the instrument has been correctly calibrated, it will read 50.0°C ± 0.1°C (122.0°F ± 0.2°F). If it does not, repeat calibration procedure.
5. To calibrate the low-battery indicator:

   Remove the battery from the case and disconnect the decade boxes.
   a. Set output of the DC voltage source to 7.5 volts.
   b. Observing the correct polarities, connect voltage source to the battery clips located inside the battery compartment.
   c. Adjust P5 slowly until the BAT. LOW arrow appears in the upper left-hand corner of the display.

NOTE: See Tables T_1 and T_2 on Pages 46 and 47 for Resistance Values for OMEGA "700" Series Linear Response Thermistors.

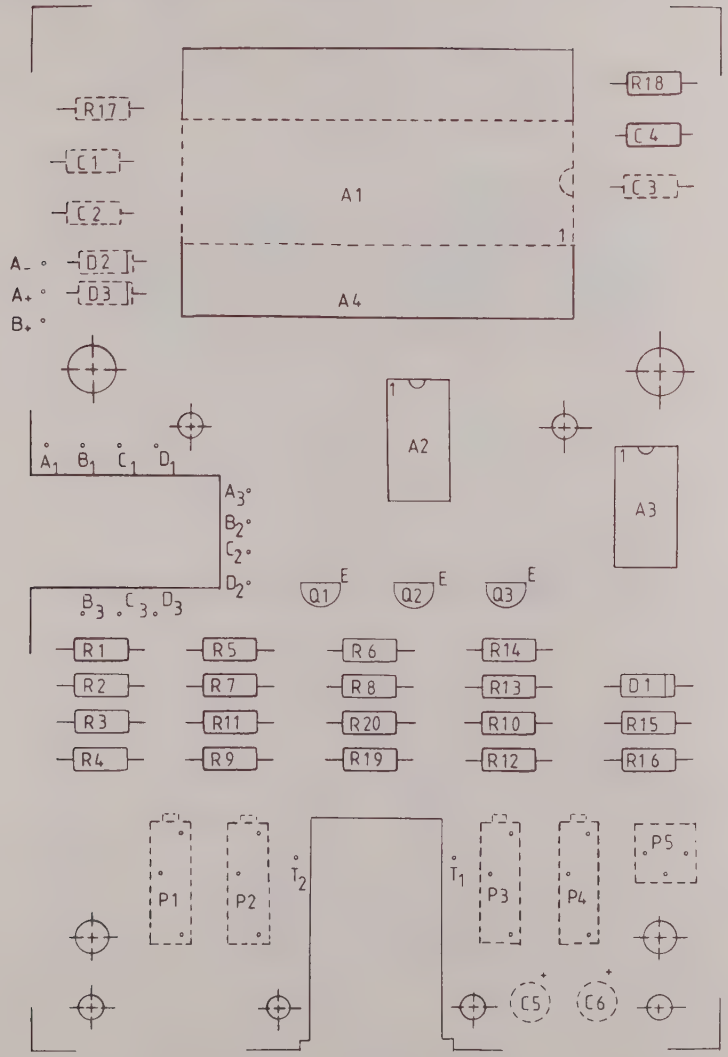
4. SERVICE INFORMATION

4.1 Parts List

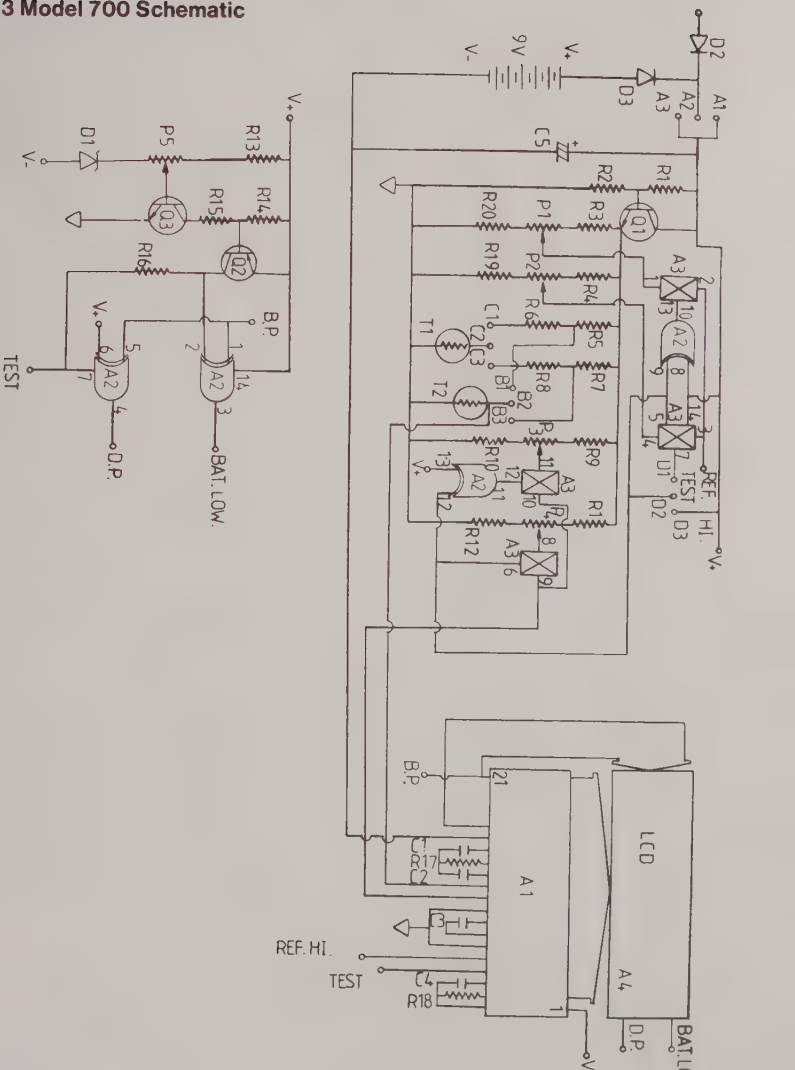
	Resistor		
R1	10K	R11	2.21K (806)
R2	6.8K	R12	18.2K
R3	5.36K (11.8K)	R13	22K
R4	13.2K (20K)	R14	22K
R5	18.7K	R15	47K
R6	35.25K	R16	120K
R7	3.2K	R17	240K
R8	6.25K	R18	100K
R9	9.76K (10K)	R19	15K (8.25K)
R10	18.2K (34.8K)	R20	11.8K (6.98K)
	Transistor		**Diode**
Q1	C945 NPN	D1	RD5AM ZENER
Q2	A733 PNP	D2	1N 4001
Q3	C945 NPN	D3	1N 4001
	Capacitor		**Integrated Circuit**
C1	0.22 μf	A1	7106
C2	0.1 μf	A2	14070
C3	0.1 μf	A3	4016
C4	100pf	A4	L.C.D. Display
	Variable Resistor		
P1	1K		
P2	1K		
P3	1K		
P4	1K		
P5	10K		

NOTE: Values in parenthesis ( ) are for Model 700F.

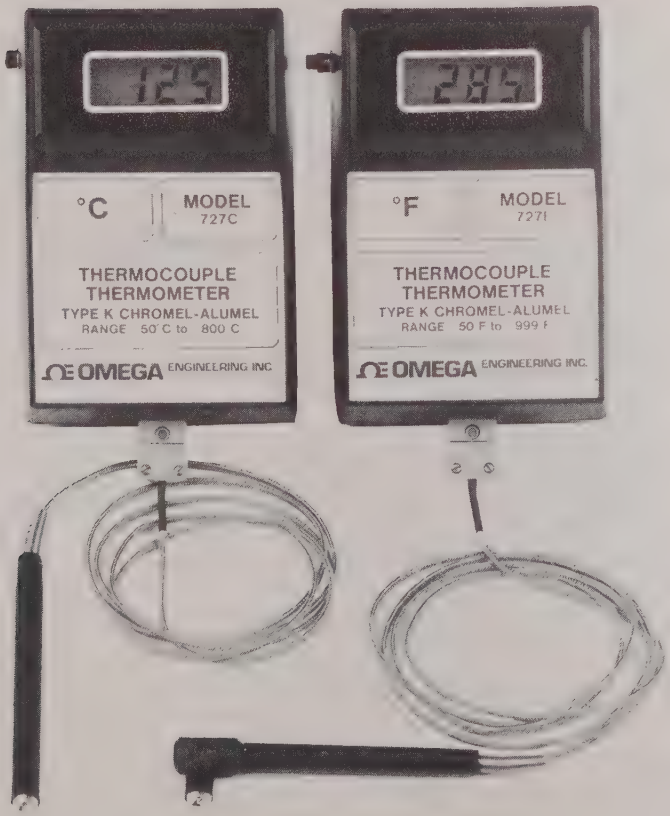
4.2 **Model 700 Circuit Board Diagram**



4.3 Model 700 Schematic



OMEGA
Model 727 Hand-held Digital Thermometer for Type "K" Thermocouples



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1. INTRODUCTION

1.1 General Description

The Model 727 Hand-held Digital Thermometer is designed for use with Type K (Chromel Alumel™) thermocouples. Featuring 1° resolution, the model is available in two styles:

Model 727F — with a range of −50° F to +999°F
Model 727C — with a range of −50°C to +800°C

Each is housed in an attractive but rugged high-impact plastic case with an OMEGA SMP Type "K" compensated miniature female thermocouple connector.

The Model 727 is highly portable, versatile and features a bright LED display. It operates on 6 Type "AA" batteries or AC adaptor (optional).

1.2 Features

- For use with Type "K" Thermocouples
- 1° Resolution
- 3-Digit LED Display
- Receptacle for AC Adaptor
- Cold-junction Compensation
- Low-battery Indicator

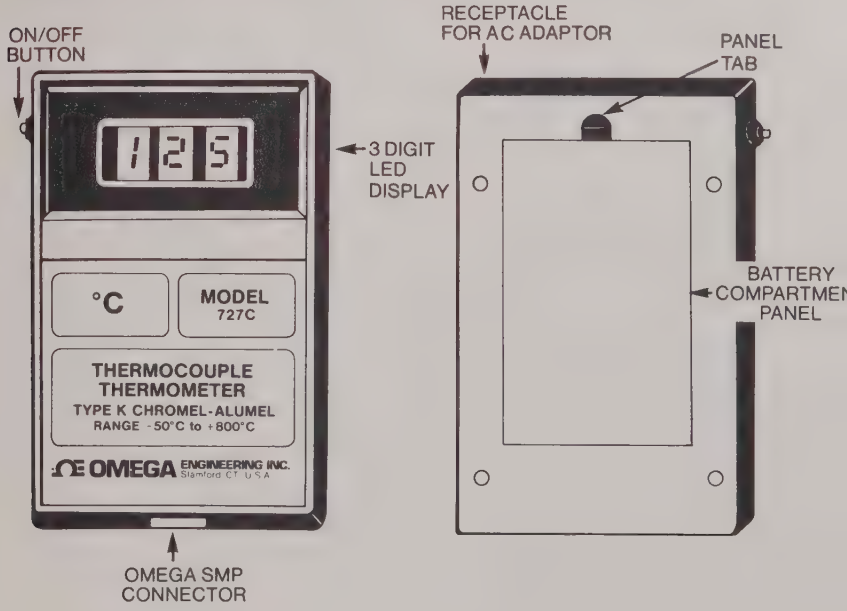
1.3 Specifications

	727C	727F
Temperature Range:	−50°C to +800°C	−50°F to +999°F
Resolution:	1°C	1°F
Accuracy:	±0.2% of reading ±2°C	±0.2% of reading ±2°F
Cold-junction Compensation:	0.05° C/°C	0.05° F/°F
Ambient Temperature:	0°C to 40°C	32°F to 104°F
Display:	0.3" Red LED	
Power:	6 Type "AA" batteries or optional 110-VAC or 220-VAC AC line adaptor	
Battery Life:	20 hours continuous, or hundreds of short-duration readings	
Size:	5.4" L x 3.6" W x 1.9" H	
Weight:	8.3 oz. (without batteries)	

1.4 Options and Accessories

AC Adaptor	— 110-VAC or 220-VAC Adaptor is optional. 110-VAC Adaptor *(Catalog No. ACD-110)* 220-VAC Adaptor with DIN Standard European Plug *(Catalog No. ACD-220)*
Soft Carrying Case	— Constructed of vinyl-coated fabric. Case includes cutout for display, removable shoulder strap and spring clip belt attachment. *(Catalog No. SC-727)*
Rugged Carrying Case	— Constructed of high-impact plastic for heavy-duty use. Case is fitted with resilient foam insert with recessed storage areas for the instrument, AC Adaptor and temperature probe(s). *(Catalog No. RCC-700)*
Replacement Batteries	— Set of 6 Type "AA" Alkaline Batteries: Mallory or equivalent. *(Catalog No. MN-1500-6)*

Figure 1 Front and Back View of Instrument



2. OPERATION

NOTE: The Model 727 is shipped with a black stopper on the switch shaft to prevent the instrument from turning ON during shipping. This stopper must be removed in order to depress the ON/OFF switch.

2.1 Battery Installation

Use 6 Type "AA" batteries. Lift the panel from the back of the instrument by pushing the panel tab toward the panel *(see Figure 1)*. Place the batteries into the compartment in accordance with the polarities indicated on the bottom of the compartment. Replace the panel.

2.2 Battery Check and Replacement

When the battery voltage is low, a decimal point will light up in the lower right-hand corner of each digit. To ensure instrument accuracy, replace the batteries as soon as low battery voltage is indicated.

When the instrument is not used for an extended period of time, remove the batteries to minimize drain and prevent leakage.

2.3 AC Operation

Plug the optional AC Adaptor into the receptacle at the top of the unit. Power from the AC adaptor overrides the push button switch (which controls the power from the battery circuit) and provides continuous power to the instrument. Therefore, it is not necessary to depress the "ON" button, and the batteries may be left in their compartment.

2.4 Probe Use

Virtually any of OMEGA's Type "K" Thermocouples or Probe Assemblies can be used with the Model 727 Thermometer. (*See* OMEGA's latest *Temperature Measurement Handbook* describing a wide range of thermocouples and assemblies for most general applications and for a wide selection of surface probes. Grounded, ungrounded and exposed junction probes can be used with the Model 727.

2.5 Connectors

The Model 727 is equipped with a built-in OMEGA SMP Type "K" female connector which mates with an OMEGA sub-miniature SMP or miniature NMP male Type "K" thermocouple alloy connector. Both the SMP and NMP connectors accept wire sizes up to 24-gage.

2.6 Lead Wire

Use only Type "K" thermocouple wire between the probe and the instrument. The accuracy rating of the Model 727 is based on a resistance of 100 ohms or less when the thermocouple element is combined with the thermocouple lead wire. For example, 26-gage lead wire should not exceed a length of 40 feet. (See OMEGA's latest *Temperature Measurement Handbook* for a wide selection of Thermocouple Wires and wire sizes plus resistance data.)

2.7 Measurement Instructions

1. Connect the thermocouple probe to the Model 727 by using an OMEGA SMP-K-M or NMP-K-M connector.
2. Place the thermocouple probe in thermal contact with the area being measured. A high-thermal conductivity paste, such as OMEGATHERM 201, will improve response time and accuracy when taking surface measurements up to 400°F (200°C). When measuring a liquid, immerse at least 1 inch of the probe.
3. Firmly press the ON/OFF button. Upon releasing, allow time for the display to stabilize and take reading. After each reading, turn the instrument OFF by depressing the ON/OFF switch again to prolong battery life.

NOTE: The Model 727 has a built-in cold-junction compensator for taking measurements in ambient temperatures between 32°F and 104°F (0°C to 40°C).

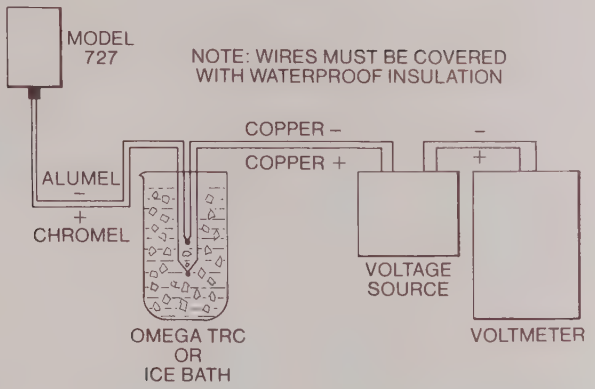
3. CALIBRATION

3.1 Calibration Equipment

1. Stable DC millivolt source.

   (**NOTE:** If there is difficulty in maintaining stability, a 1-to-1 buffer amplifier may be needed.)
2. Digital voltmeter having at least 10-microvolt resolution.
3. OMEGA TRC Ice Point Reference Chamber (or ice bath consisting of equal parts of crushed ice and water, stirred regularly in a thermos or Dewar flask).
4. OMEGA Type "K" TRP Reference Probe. If unavailable, a reference probe can be fabricated by silver soldering Type "K" thermocouple wire to copper leads. Note: Observe the polarities in *Figure 2*. Both wires should be insulated with waterproof PVC or Teflon.

Figure 2
Equipment setup for calibration procedure



3.2 **Calibration Procedure**

1. Open the instrument to expose the circuit board by removing the 4 screws from the back of the instrument.
2. Refer to Section 4.2 and locate potentiometers P1, P2, and P3 on PC board.
3. Refer to *Table 1* and calibrate the ZERO scale first by setting the input voltage to zero and adjusting P2 until the display reads 0°C or 32°F. Follow with the MIDDLE scale, then the FULL scale, using the appropriate millivolt values and potentiometers as shown in *Table 1*.
4. Repeat the above procedure to insure an accurate calibration.

TABLE 1

	Potentiometer	Input Voltage (mV)	Temperature
Model 727F			
Zero Scale	P2	0	32°F
Middle Scale	P1	10.560	500°F
Full Scale	P3	22.227	999°F
Model 727C			
Zero Scale	P2	0	0°C
Middle Scale	P1	16.395	400°C
Full Scale	P3	33.227	800°C

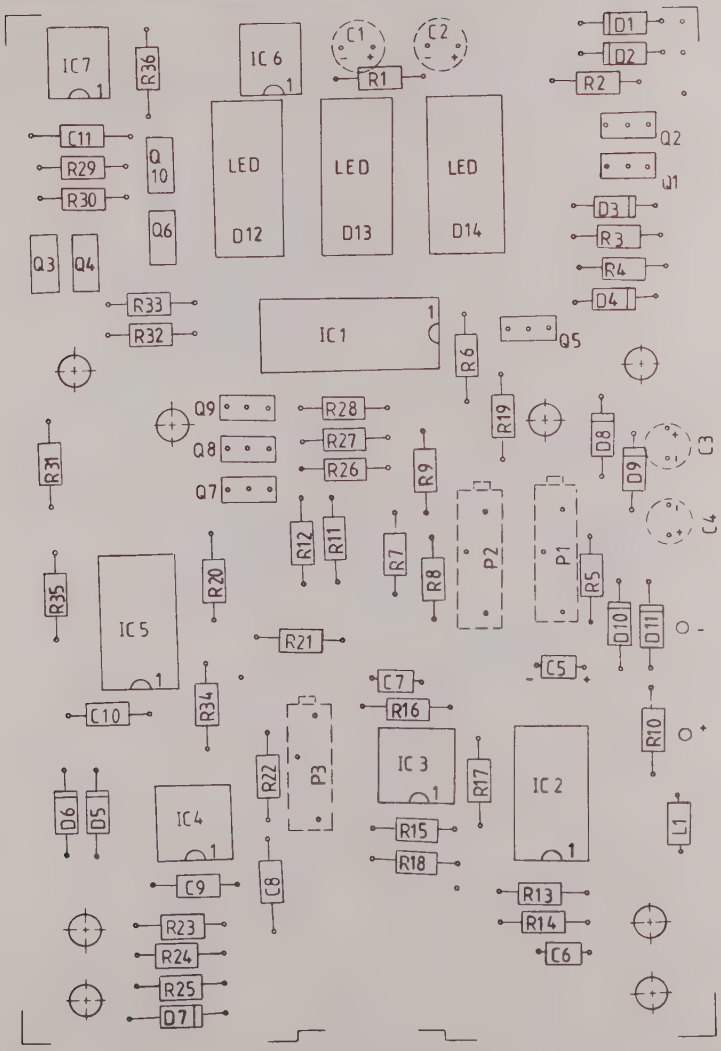
4. SERVICE INFORMATION

4.1 Parts List — Models 727C and 727F

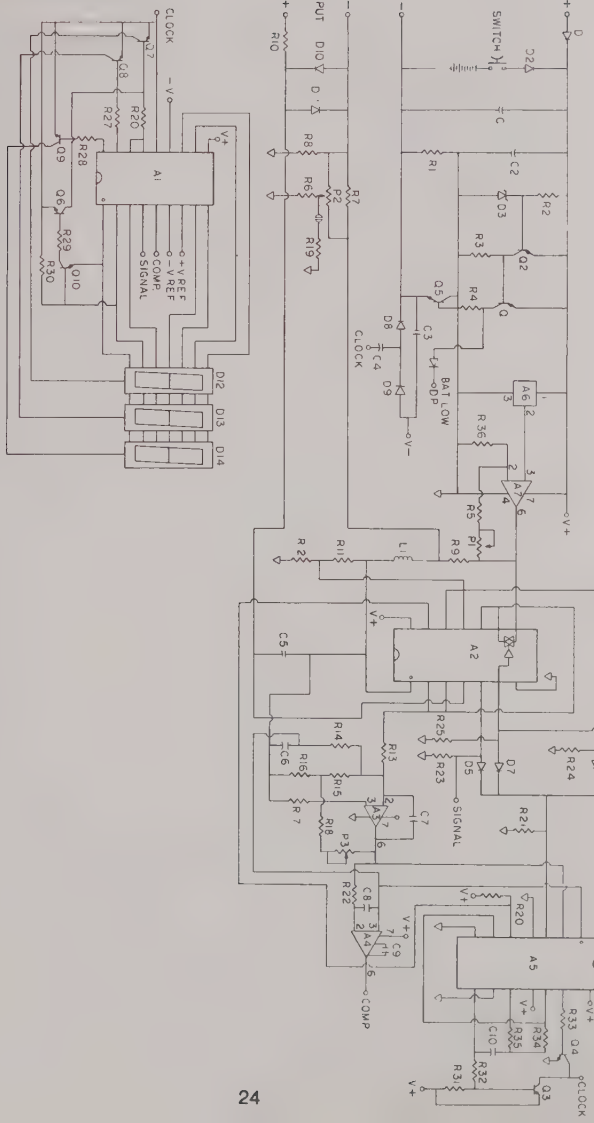
NOTE: Values in parenthesis ( ) are for Model 727F.

R1	10K	Q1	A733	A1	AY-5-3507
R2	120	Q2	A733	A2	MC14066B
R3	100K	Q3	A733	A3	MC1744
R4	1K	Q4	C945	A4	LM301AN
R5	7.32K (5.62K)	Q5	C945	A5	CD4007CN
R6	390K	Q6	C945	A6	1403U
R7	105 (97.6)	Q7	C945	A7	LM741
R8	43.2K	Q8	C945		
R9	30.1 (16.5)	Q9	C945		
R10	5.62K	Q10	A733		
R11	39.2 (22.1)				
R12	2K	C1	47 μf 50V		
R13	68K	C2	47 μf 50V		
R14	1M	C3	47 μf 50V		
R15	150K	C4	47 μf 50V		
R16	1.5K	C5	33 μf 6.3V		
R17	1.5K	C6	33 μf 6.3V		
R18	180K (330K)	C7	0.068 μf (0.47 μf)		
R19	560K (330K)	C8	300pf		
R20	47K (10K)	C9	1pf (0.5pf)		
R21	10K	C10	300pf		
R22	2.2K	C11	300pf		
R23	47K	C12	0.001 μf		
R24	47K				
R25	47K	D1	1N4002		
R26	4.7K	D2	1N4002		
R27	4.7K	D3	RD5AM		
R28	4.7K	D4	1N914		
R29	10K	D5	1N914		
R30	10K	D6	1N914		
R31	10K	D7	1N914		
R32	1.5K	D8	1N914		
R33	1.5K	D9	1N914		
R34	180K	D10	1N914		
R35	240K	D11	1N914		
R36	15K (13.3K)	D12	HP-5082-7613		
		D13	HP-5082-7613		
		D14	HP-5082-7613		

4.2 Model 727 Circuit Board Diagram



4.3 Model 727 Schematic



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Model 737 Hand-held Digital Thermometer for 100 ohm Platinum RTD's ($\alpha = 0.00385$)

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1. INTRODUCTION

1.1 General Description

The Model 737 Hand-held Digital Thermometer is an accurate, reliable instrument designed specifically for use with all OMEGA 100 ohm (α = 0.00385) 3-wire RTD probes.

The model reads in either °C or °F on an LCD display. The scale is easily selectable with a rocker switch which covers the full RTD range of −148°F to +1562°F and −100°C to +850°C.

The instrument is housed in an attractive, rugged high-impact plastic case fitted with an OMEGA OTP polarized RTD female connector. It is highly portable, versatile and easy to read. It operates on a 9-volt transistor battery or optional AC adaptor.

1.2 Features

- Selectable °C or °F switch
- 100 ohm (α = 0.00385) 3-wire Platinum RTD
- 1°Resolution
- 3½ Digit LCD Display
- Receptacle for AC Adaptor
- Low-battery Indicator

1.3 Specifications

Temperature Range: −148°F to +1562°F; −100°C to +850°C

Resolution: 1°F, 1°C

Accuracy: ±0.2% Reading, ±1°F or °C

Ambient Temperature: 0°C to 40°C

Display: 0.5" LCD

Power: One 9V Battery or Optional 110-VAC or 220-VAC, AC Line Adaptor

Battery Life: 100 hours (continuous)

Size: 5.4" L x 3.6" W x 1.9" H

Weight: 9.2 oz. (without battery)

1.4 Options and Accessories

AC Adaptor — 110-VAC or 220-VAC Adaptor is optional. 110-VAC Adaptor *(Catalog No. ACD-110)* 220-VAC Adaptor with DIN Standard European Plug *(Catalog No. ACD-220)*

Soft Carrying Case — Constructed of a vinyl-coated fabric. Case includes cut-out for display, removable shoulder strap and spring clip belt attachment. *(Catalog No. SC-737)*

Rugged Carrying Case — Constructed of high-impact plastic for heavy-duty use. Case is fitted with a resilient foam insert with recessed storage areas for the instrument, AC adaptor and temperature probe(s). *(Catalog No. RCC-700)*

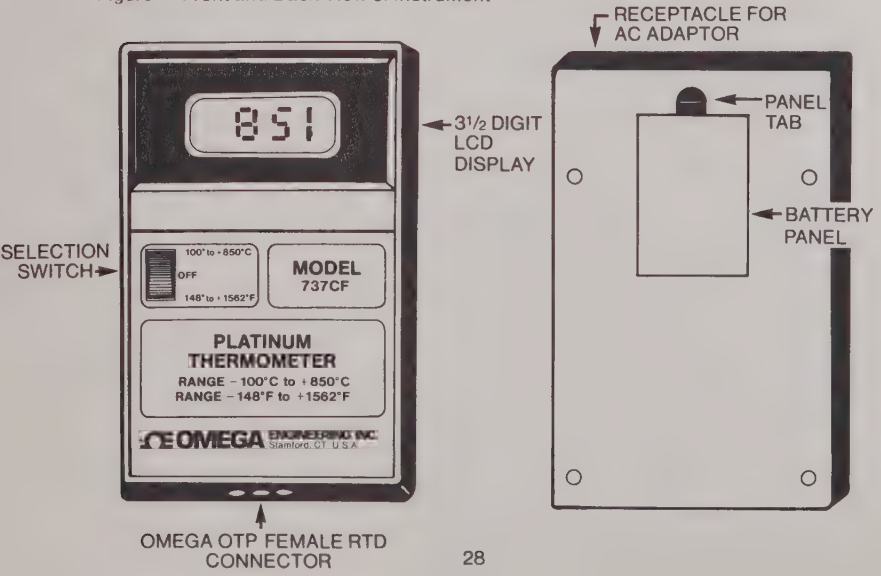
Replacement Battery — Single 9-volt battery: Mallory or equivalent. *(Catalog No. MN1604)*

2. OPERATION

2.1 Battery Installation

Use the specified 9-volt transistor battery. Lift off the panel from the

Figure 1 Front and Back View of Instrument



back of the instrument by pushing the panel tab toward the panel *(see Figure 1)*. Place the battery into the compartment in accordance with the polarities indicated on the bottom of the compartment. Replace the panel.

2.2 **Battery Check and Replacement**

When the battery voltage is low (7.5 volts or less), an arrow will appear in the upper left-hand corner of the display. To ensure instrument accuracy, replace the battery as soon as low battery voltage is indicated.

When the instrument is not used for an extended period of time, remove the battery to minimize drain and prevent leakage.

2.3 **AC Operation**

Plug the optional AC adaptor into the receptacle located at the top of the unit. Power from the adaptor overrides the battery circuit; therefore it is not necessary to remove the batteries for AC operation. Then plug the adaptor into a standard 110-VAC 60 Hz outlet. 220-VAC adaptors are supplied with a DIN European plug.

2.4 **Probe Use**

The OMEGA Model 737 is designed to be used in conjunction with any 100 ohm (α = 0.00385) 3-wire platinum RTD.

Paragraph 2.6 outlines maximum lead wire length. See the *OMEGA Temperature Measurement Handbook* featuring a broad selection of platinum RTD elements and probes.

2.5 **Connectors**

The Model 737 has a built-in OMEGA OTP polarized RTD female connector which mates with an OMEGA OTP-CU-M 3-prong uncompensated male connector.

2.6 **Lead Wire**

The accuracy specifications of the Model 737 are based on a resistance of 0.3 ohms or less for each of the three lead wires. Therefore, the length and gage of the copper leads should be taken into account. For example, 7 feet of 26-gage or 12 feet of 24-gage copper wire is the maximum lead length which will have the 0.5 ohms or less resistance.

2.7 Measurement Instructions

1. Connect the RTD probe to the Model 737 by inserting connector firmly into the instrument. (An OMEGA OTP-CU-M connector is required.)
2. Place the RTD probe in thermal contact with the area being measured. A high-thermal conductivity paste, such as OMEGATHERM 201, will improve response time and accuracy when taking surface measurements up to 400°F (200°C). When measuring a liquid, immerse at least 2 inches of the RTD probe.
3. Select a temperature range, then turn the instrument on by depressing the rocker switch to that range.
4. Allow the display to stabilize and take reading. Turning the instrument off after each reading will prolong battery life.

3. CALIBRATION

3.1 Calibration Equipment

1. 400 ohm decade resistance box with 0.01 ohms resolution.
2. 3-wire copper lead with OMEGA OTP-CU-M (3-prong, uncompensated male connector) *(see Figure 2).*
3. 7.5 volt DC source (for low-battery indicator).

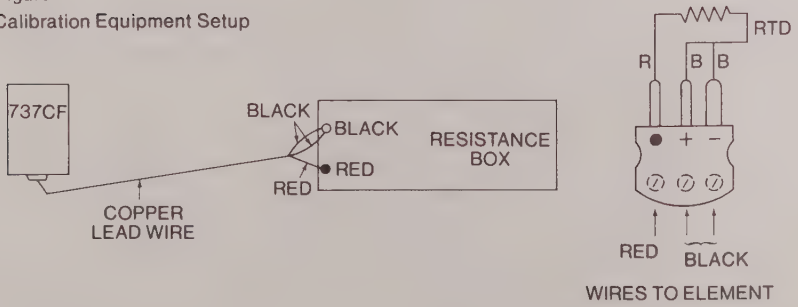
3.2 Calibration Procedure

1. Open the Model 737 to expose the PC board by removing the 4 screws from the back of the unit.
2. Refer to Par. 4.2 and locate the potentiometers (P1 through P7) on the PC board.
3. Set rocker switch to the −100°C to +850°C scale.
   a. Connect the resistance box to the instrument via copper leads *(see Figure 2).*
   b. Set P4 to mid-range by turning it 18 turns clockwise, then 9 turns counterclockwise.
   c. Set resistance box to 100.00 ohms and adjust P2 for a display reading of 000.
   d. Set resistance box to 390.38 ohms and adjust P6 for a reading of 850°C.

e. Set resistance box to 212.03 ohms. The meter should read 300°C. If a reading is greater than 300°C, turn P4 clockwise until meter reads 300°C and repeat Steps c, d and e. If reading is less than 300°C, turn P4 counterclockwise until meter reads 300°C and repeat Steps c, d and e.

4. Set rocker switch to the −148°F to +1562°F scale.
   a. Set P3 to mid-range by turning it 18 turns clockwise, then 9 turns counterclockwise.
   b. Set resistance box to 100.00 ohms and adjust P1 for a reading of 32°F.
   c. Set resistance box to 390.38 ohms and adjust P7 for a reading of 1562°F.
   d. Set resistance box to 212.03 ohms. The meter should read 572°F. If reading is greater than 572°F, turn P3 clockwise until meter reads 572°F. Repeat Steps b, c and d. If reading is less than 572°F, turn P3 counterclockwise until meter reads 572°F. Repeat Steps b, c and d.
   e. Set resistance box to 60.20 ohms and adjust P5 for a reading of −147°F.
5. To calibrate the low-battery indicator:
   a. Remove battery from its compartment.
   b. Set voltage source to 7.5 VDC.
   c. Locate 2 battery clips inside compartment and while observing the correct polarities, connect voltage source to battery clips.
   d. Adjust P8 slowly until BAT. LOW arrow appears.

Figure 2
Calibration Equipment Setup

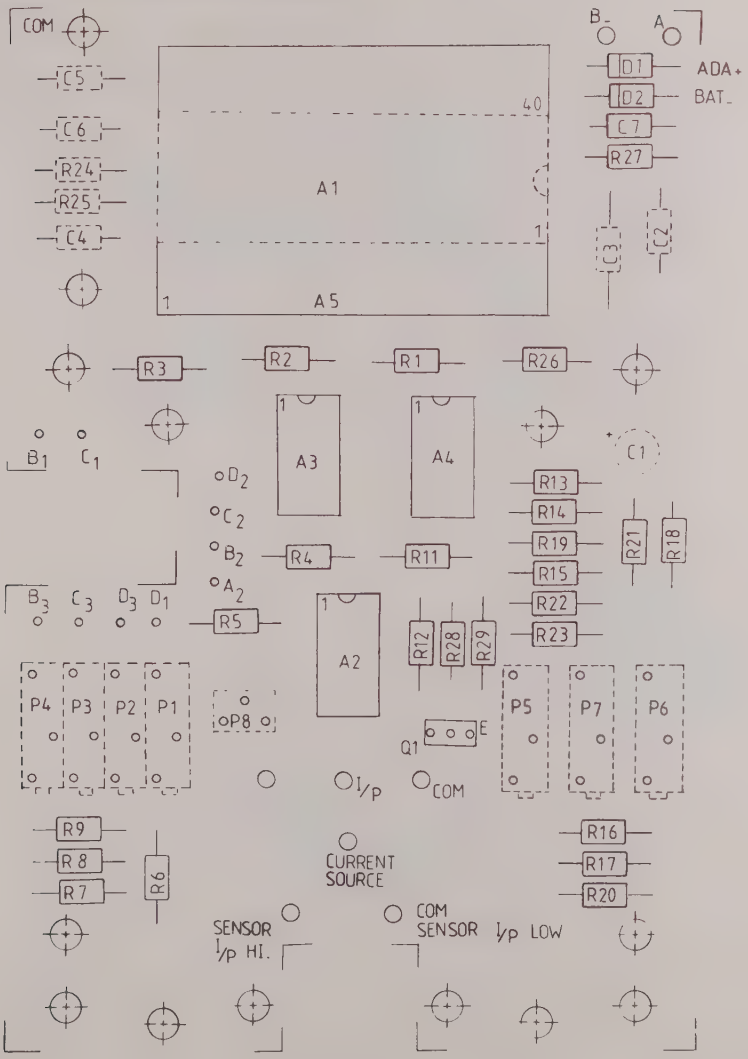


4. SERVICE INFORMATION

4.1 Parts List — Model 737

R1	4.32	P1	1K	A1	7106
R2	2.21K	P2	1K	A2	LM324
R3	360	P3	1K	A3	CD4070
R4	510	P4	1K	A4	MC14066
R5	105	P5	1K		
R6	1.8K	P6	1K		
R7	510	P7	1K		
R8	5.62K	P8	10K		
R9	1M				
R10		Q1	A733		
R11	1K				
R12	10K	C1	100 μf 16V		
R13	8.25K	C2	0.22 μf		
R14	130	C3	0.47 μf		
R15	182	C4	0.01 μf		
R16	150	C5	0.22 μf		
R17	240	C6	0.22 μf		
R18	182	C7	100 pf		
R19	30.1K				
R20	15K	D1	1N4002		
R21	30.1K	D2	1N4002		
R22	47K				
R23	47K				
R24	200K				
R25	1M				
R26	47K				
R27	100K				

4.2 Model 737 Circuit Board Diagram



4.3 Model 737 Schematic

OMEGA
Model 747
Portable Bench-top
Digital Thermometer
for Thermistors

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1. INTRODUCTION

1.1 General Description

The Model 747 Digital Thermistor Thermometer is a portable bench-top instrument which allows the user to obtain a temperature reading of two probes as well as the temperature differential between the two probes. It is compatible with all OMEGA "700" Series Thermistor Probes. A selection switch permits readings in °C or °F. Other features include a linearized analog output for driving devices (such as strip chart recorders), an easy-to-read LCD display, and 0.1° resolution.

The Model is supplied with 6 Type "AA" batteries, an AC adaptor, and a rugged high-impact plastic carrying case.

1.2 Features

- Compatible with any OMEGA "700" Series Thermistor Probes
- °C or °F Selection Switch
- Two Sensor Inputs and Differential Temperature
- Analog Output
- AC Adaptor
- Low-battery Indicator
- 3½ Digit LCD Display
- 0.1° Resolution
- Carrying Case

1.3 Specifications

Sensors:	Two "700" Series Thermistors	
Temperature Range:	−30.0°C to +50.0°C	−22.0°F to +122.0°F
	0.0°C to +100.0°C	+32.0°F to +199.9°F
Resolution:	0.1°C	0.1°F
Accuracy:*		
Temperature:	0.5°C	0.85°F
Differential Temperature:	1.0°C	1.7°F
Display:	0.5" LCD	
Battery Power:	6 Type "AA" batteries	
AC Power Adaptor:	110-VAC, 60 Hz, or 220-VAC, 50 Hz	
Operation Temperature:	+5°C to +35°C, +41°F to +95°F	
Storage Temperature:	−15°C to +55°C, +5°F to +131°F	

*Includes "700" Series Thermistor Probe and instrument within operating temperature and relative humidity specifications.

Specifications (cont.)

Humidity:	85% relative humidity
Dimensions:	
Instrument:	7.9" W x 4.7" L x 2.5" H
Carrying Case:	12.4" W x 8.3" L x 4.0" H
Weight: (Instrument)	27 oz.

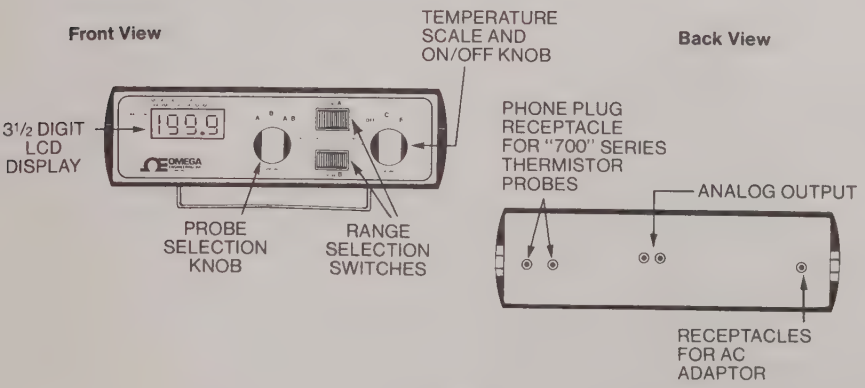
Analog Output: (into a 1000 ohms or greater device, accuracy ±1%)

Range	Output
−30.0°C to +50.0°C	11.4 mV/°C
0.0°C to +100.0°C	9.00 mV/°C
−22.0°F to 122.0°F	6.3 mV/°F
+32.0°F to +199.9°F	5.00 mV/°F

1.4 Accessories (supplied with instrument)

110-VAC Adaptor or 220-VAC Adaptor	— Plugs into a standard 110-VAC, 60 Hz wall receptacle. Supplied with DIN standard European plug for 220-VAC, 50 Hz wall receptacle.
Rugged Carrying Case	— Constructed of high-impact plastic for heavy-duty use. Case is fitted with resilient foam insert with recessed storage areas for the instrument, AC adaptor and temperature probe(s).
Replacement Batteries	— Set of 6 "AA" alkaline batteries: Mallory or equivalent *(Catalog No. MN-1500-6)*

Figure 1 Front and Back View of Instrument



2. OPERATION

2.1 Battery Installation

Use 6 Type "AA" batteries. The battery compartment is located on the bottom of the instrument. Lift the panel by pushing the tab toward the panel, and place the batteries into the compartment in accordance with the polarities indicated on the bottom of the compartment. Replace the panel.

2.2 Battery Check and Replacement

When the battery voltage is low, an arrow will appear in the upper left-hand corner of the display. To ensure instrument accuracy, replace the batteries as soon as the low-battery voltage is indicated.

When the instrument is not used for an extended period of time, remove the batteries to minimize drain and prevent leakage.

2.3 AC Operation

To power the Model 747 from an alternating current source, insert the AC adaptor into the receptacle marked "POWER" on the back of the instrument. The 110-VAC Adaptor plugs into a standard 110-volt, 60-Hz wall outlet. Since the power from the adaptor overrides the battery circuit, it is not necessary to remove the batteries from the compartment for AC operation. The 220-volt, 50-Hz adaptor is supplied with a DIN European Plug.

2.4 Probes, Connectors and Lead Wire

The Model 747 accepts either one or two "700" Series Thermistor Probes. They fit into two receptacles built into the back of the instrument marked "Probe A" and Probe B". These receptacles mate with "phone plug" termination style probes. When ordering OMEGA "700" Series Thermistor Probes, add the suffix "PP" to the probe number and specify "with phone plug." See OMEGA's latest *Temperature Measurement Handbook* for a broad selection of thermistors and thermistor probe assemblies.

The accuracy specifications are based on a probe with a lead resistance of 0.5 ohms or less for each of the three lead wires on each probe. Therefore, the length and gage of the copper leads should be taken into account. For example, lead wire length should not exceed 19 feet of 24-gage wire for each OMEGA "700" Series Thermistor Probe. (OMEGA "700" Series Thermistor Probes are normally supplied with 10 feet of 24-gage wire.)

2.5 Instrument Functions and Operation

Analog Output

The Model 747 has a linearized analog output located on the back of the instrument. The two receptacles marked "Recorder" accept standard banana plug connectors. The RED receptacle is positive; the BLACK is negative. When using the analog output in the "A-B" position, both "Probe A" and "Probe B" must be on the same temperature range. The analog output will drive devices having an input impedance greater than 1000 ohms.

The following chart lists the millivolt outputs for the various temperature ranges:

Range	Output
−30.0°C to +50.0°C	11.4 mV/°C
0.0°C to +100.0°C	9.00 mV/°C
−22.0°F to +122.0°F	6.3 mV/°F
+32.0°F to +199.9°F	5.00 mV/°F

Range Selection

Two rocker switches labeled "Probe A" and "Probe B" located on the face of the instrument permit selection of two temperature ranges for each probe. Selection of the ranges depends upon the temperature being measured. For example, for temperatures over 50°C or 32°F, the upper ranges should be selected.

Probe and Scale Selection

The two knobs located on the face of the instrument select the probe and degree scale. The knob labeled "DEGREE" turns the instrument "ON" and selects the degree scale (Celsius or Fahrenheit). The other knob labeled "PROBE" selects the mode of operation. The "A" or "B" position reads the temperature of "Probe A" or "Probe B", respectively. The "A-B" position reads the temperature differential between "Probe A" and "Probe B". When using the "A-B" temperature differential position, both rocker switches must be on the same temperature range.

2.6 Measurement Instructions

1. Firmly insert the "700" Series Thermistor Probes all the way into the receptacles marked "Probe A" or "Probe B" located on the back of the instrument.
2. Place the thermistor probe in thermal contact with the area being measured. The use of a high-thermal conductivity compound such as OMEGATHERM 201 will improve response time and accuracy when making measurements below 400°F (200°C). When measuring a liquid, immerse the probe at least 1 inch.
3. Turn the instrument on and select a degree scale and then a temperature range (see Section 2.5).

4. Allow the display to stabilize before recording the reading.

(**NOTE:** To maximize battery life, turn the instrument off after each reading.)

3. CALIBRATION

3.1 Calibration Equipment

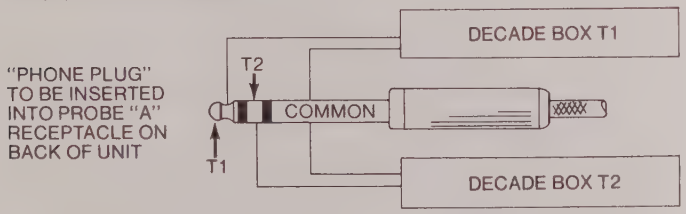
1. Two decade boxes (T1 and T2) are required to produce the following resistance values:

T_1	T_2
19.59 K Ω	94.98 K Ω
407.6 Ω	2069 Ω
106.2 K Ω	481.0 K Ω
549.8 Ω	2799 Ω
2162 Ω	10.97 K Ω

2. Wire assembly with phone plug *(see Figure 2)*
3. Calibrated digital multimeter (DMM) (for analog output calibration)
4. 7.5 VDC voltage source (for BAT. LOW arrow)

Figure 2

Set equipment up as follows:



3.2 Calibration Procedure

1. Open the instrument case by pulling the 4 rubber feet off and removing the 4 screws (located under the feet). Grasp the top and bottom of the instrument case and carefully pull it apart.
2. Refer to the Circuit Board Diagram (Section 4.2) and locate Potentiometers P1 through P12.
3. Insert phone plug into "Probe A" input and rotate probe switch to the "A" position.
4. Set degree scale to the °C position and calibrate as follows:
   a. Set "Probe A" range switch to 0°C to 100°C position.
   b. Set T_1 = 19.59 K Ω
      Set T_2 = 94.98 K Ω
      Adjust P8 for a reading of +0.2°C.

c. Set $T_1 = 407.6\ \Omega$ Adjust P2 for a
$T_2 = 2069\ \Omega$ reading of +100.0°C.

d. Repeat Steps "b" and "c" until both readings are correct.

e. Set "Probe A" range switch to −30°C to +50°C position.

f. Set $T_1 = 19.59\ K\ \Omega$ Adjust P7 for a
$T_2 = 94.98\ K\ \Omega$ reading of +0.1°C.

g. Set $T_1 = 106.2\ K\ \Omega$ Adjust P1 for a
$T_2 = 481.0\ K\ \Omega$ reading of −30.0°C.

h. Repeat Steps "f" and "g" until both readings are correct.

5. Set Degree Scale to °F position.

a. Set "Probe A" range switch to +32.0°F to 199.9°F position.

b. Set $T_1 = 19.59\ K\Omega$ Adjust P6 for a
$T_2 = 94.98\ K\Omega$ reading of +32.3°F.

c. Set $T_1 = 549.8\Omega$ Adjust P4 for a
$T_2 = 2799\Omega$ reading of +194.0°F.

d. Repeat steps "b" and "c" until both readings are correct.

e. Set "Probe A" range switch to −22.0°F to +122.0°F position.

f. Set $T_1 = 19.59\Omega$ Adjust P5 for a
$T_2 = 94.98\ K\Omega$ reading of +32.2°F.

g. Set $T_1 = 2162\Omega$ Adjust P3 for a
$T_2 = 10.97\ K\Omega$ reading of +122.2°F.

h. Repeat steps "f" and "g" until both readings are correct.

6. Calibration of Analog Output

a. Connect the DMM to the recorder output observing correct polarities.

b. Set "Probe A" range switch to 0°C to 100°C position.

c. Set $T_1 = 19.59\ K\Omega$ Adjust P12 until the
$T_2 = 94.98\ K\Omega$ DMM reads 0 mV.

d. Set $T_1 = 407.6\Omega$ Adjust P9 until the
$T_2 = 2069\Omega$ DMM reads 900 mV.

7. To calibrate the low-battery indicator:

a. Remove the batteries from the case.

b. Set output of DC voltage source to 7.5 volts.

c. Connect the positive wire of the voltage source to the positive battery clip located on the lower right-hand side of the battery compartment located toward the back of the instrument. Connect the negative wire to the negative battery clip located on the lower left.

d. Adjust P10 slowly until the BAT. LOW arrow appears in the upper left-hand corner of the display.

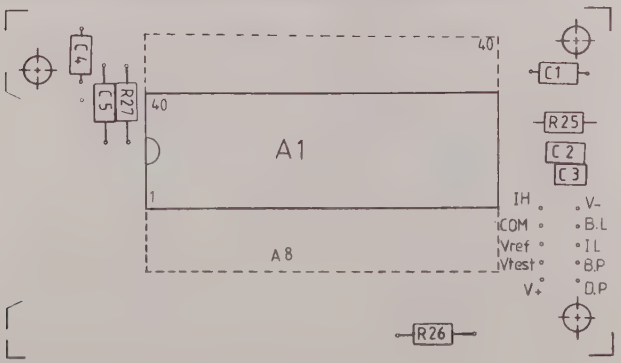
NOTE: See Tables T_1 and T_2 on Pages 46 and 47 for Resistance Values for OMEGA "700" Series Linear Response Thermistors.

4. SERVICE INFORMATION

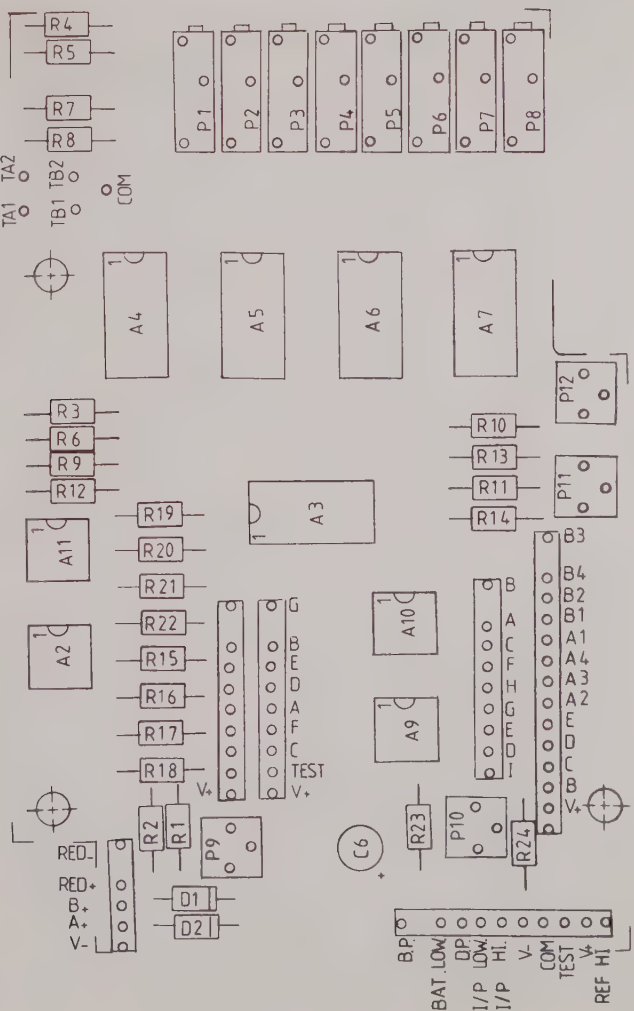
4.1 Parts List

R1	43.2K	P1	1K	A1	ICL7106CPL
R2	6.49K	P2	1K	A2	MLM324P
R3	5.36K	P3	1K	A3	CD4070BCN
R4	4.32K	P4	1K	A4	CD4066BCN
R5	6.49K	P5	1K	A5	CD4066BCN
R6	13.3K	P6	1K	A6	CD4066BCN
R7	5.62K	P7	1K	A7	CD4066BCN
R8	8.25K	P8	1K		
R9	11.8K	P9	10K		
R10	5.62K	P10	10K		
R11	34.8K				
R12	1.5K	Q1	C945		
R13	2.21K				
R14	34.8K	C1	0.22 μf		
R15	18.7K	C2	0.1 μf		
R16	35.25K	C3	0.0 μf		
R17	3.2K	C4	0.1 μf		
R18	6.25K	C5	100pf		
R19	18.7K	C6	100μf 16V		
R20	35.25K				
R21	3.2K	D1	1N4002		
R22	6.25K	D2	1N4002		
R23	1K				
R24	10K				
R25	240K				
R26	1M				
R27	100K				

4.2 Model 747 Circuit Board Diagram — Display Board



4.2 Model 747 Circuit Board Diagram — Main Board



4.3 Model 747 Schematic

Resistance Values for OMEGA "700" Series Linear Response Thermistors

Table T_1

T_1 RESISTANCE VERSUS TEMPERATURE −30 TO +100°C							
TEMP°C	RES	TEMP°C	RES	TEMP°C	RES	TEMP°C	RES
−30	100.2K	+10	11.94K	+50	2162	+ 90	549.8
29	99.82K	11	11.38K	51	2080	91	533.2
28	93.88K	12	10.85K	52	2004	92	517.2
27	88.32K	13	10.35K	53	1930	93	501.8
26	83.12K	14	9878	54	1859	94	486.8
25	78.26K	15	9428	55	1792	95	472.4
24	73.72K	16	9000	56	1727	96	458.6
23	69.46K	17	8594	57	1664	97	445.2
22	65.48K	18	8210	58	1605	98	432.2
21	61.74K	19	7844	59	1547	99	419.6
−20	58.26K	+20	7496	+60	1493	+100	407.6
19	54.98K	21	7166	61	1440		
18	51.90K	22	6852	62	1389		
17	49.02K	23	6554	63	1341		
16	46.32K	24	6270	64	1294		
15	43.78K	25	6000	65	1249		
14	41.40K	26	5744	66	1207		
13	39.16K	27	5500	67	1165		
12	37.04K	28	5266	68	1126		
11	35.06K	29	5046	69	1087		
−10	33.20K	+30	4834	+70	1051		
9	31.49K	31	4634	71	1016		
8	29.80K	32	4442	72	981.8		
7	28.24K	33	4260	73	949.4		
6	26.78K	34	4084	74	918.0		
5	25.40K	35	3918	75	888.0		
4	24.10K	36	3760	76	859.0		
3	22.88K	37	3610	77	831.2		
2	21.72K	38	3466	78	804.4		
− 1	20.62K	39	3328	79	773.6		
0	19.59K	+40	3196	+80	753.8		
+ 1	18.62K	41	3070	81	729.8		
2	17.70K	42	2950	82	706.8		
3	16.83K	43	2836	83	684.4		
4	16.01K	44	2726	84	663.0		
5	15.24K	45	2620	85	642.4		
6	14.50K	46	2520	86	622.6		
7	13.81K	47	2424	87	603.4		
8	13.15K	48	2334	88	584.8		
9	12.53K	49	2246	89	567.0		

Table T_2

T_2 RESISTANCE VERSUS TEMPERATURE −30 TO +100°C							
TEMP°C	RES	TEMP°C	RES	TEMP°C	RES	TEMP°C	RES
−30	481.0K	+10	58.75K	+50	10.97K	+ 90	2799
29	453.5K	11	56.07K	51	10.57K	91	2714
28	427.7K	12	53.54K	52	10.18K	92	2632
27	403.5K	13	51.13K	53	9807	93	2552
26	380.9K	14	48.84K	54	9450	94	2476
25	359.6K	15	46.67K	55	9109	95	2402
24	339.6K	16	44.60K	56	8781	96	2331
23	320.9K	17	42.64K	57	8467	97	2262
22	303.3K	18	40.77K	58	8166	98	2195
21	286.7K	19	38.99K	59	7876	99	2131
−20	271.2K	+20	37.30K	+60	7599	+100	2069
19	256.5K	21	35.70K	61	7332		
18	242.8K	22	34.17K	62	7076		
17	229.8K	23	32.71K	63	6830		
16	217.6K	24	31.32K	64	6594		
15	206.2K	25	30.00K	65	6367		
14	195.4K	26	28.74K	66	6149		
13	185.2K	27	27.54K	67	5940		
12	175.6K	28	26.40K	68	5738		
11	166.6K	29	25.31K	69	5545		
−10	158.0K	+30	24.27K	+70	5359		
9	150.0K	31	23.28K	71	5180		
8	142.4K	32	22.33K	72	5007		
7	135.2K	33	21.43K	73	4842		
6	128.5K	34	20.57K	74	4682		
5	122.1K	35	19.74K	75	4529		
4	116.0K	36	18.96K	76	4381		
3	110.3K	37	18.21K	77	4239		
2	104.9K	38	17.49K	78	4102		
− 1	99.80K	39	16.80K	79	3970		
0	94.98K	+40	16.15K	+80	3843		
+ 1	90.41K	41	15.52K	81	3720		
2	86.09K	42	14.92K	82	3602		
3	81.99K	43	14.35K	83	3489		
4	78.11K	44	13.80K	84	3379		
5	74.44K	45	13.28K	85	3273		
6	70.96K	46	12.77K	86	3172		
7	67.66K	47	12.29K	87	3073		
8	64.53K	48	11.83K	88	2979		
9	61.56K	49	11.39K	89	2887		

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